Automatic Optimal Order selection of Parametric Modeling for the evaluation of Abnormal Intra-QRS Signals in Signal Averaged ECG

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Abstract

Abnormal intra-QRS potentials (AIQPs) in signal-averaged electrocardiograms have been proposed as a risk evaluation index for ventricular arrhythmias. The purpose of the paper was to develop an automatic algorithm for selecting the optimum parametric model order in the analysis of AIQPs to make the modelling approach clinically more feasible. A total of 130 normal Taiwanese subjects and 87 patients with ventricular premature contractions and 23 with sustained ventricular tachycardia were recruited. The unpredictable AIQP signal was estimated from the modelling residual. The cross-correlation coefficient between the original signal and the QRS estimate was employed to evaluate the accuracy of the estimate. A pre-selected threshold cross-correlation coefficient of 0.9999 was used to determine the optimum order. The mean AIQP in lead Y for ventricular tachycardia patients was 3.9 μV, which was significantly smaller than 4.9 μV for ventricular premature contraction patients ($p<0.01$) and 6.3 μV for normal subjects ($p<0.001$). The linear combination of AIQP in lead Y and the time-domain parameter RMS40 provided the best global performance (the area under the receiver operating characteristic curve was 89.1%). A higher risk of ventricular arrhythmias was associated with lower AIQP in lead Y, and the automatic modelling algorithm improved the clinical feasibility of AIQP analysis.